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Chemical Composition of *Sphyraena barracuda* with Different Area, Size and Season, in Sudanese Red Sea Coast

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Abstract

This study aims to determine the effect of area, size and season on chemical composition of *Sphyraena barracuda* from Sudanese Red Sea Coast. A total of 180 fish samples were collected from Port Sudan and Sawakin fishing sites during the winter and summer of 2020-2021. The fishes sample ranged between (30 - 50) cm in total length and (250 - 1000) gm in body weight of small size, and ranged between (60 - 90) cm in total length and (1250 - 250) gm in body weight for large size. Fish flesh was subject to gross chemical analysis. Moisture, protein, fat, ash, acidity and pH were determined. The results indicated a significant effect by area, season and size. The different areas had a significant effect on crude protein and ash; higher parameter value is found in Sawakin. Higher chemical parameters were showed in winter than in summer. Also, size had a significant effect in all parameters (except moisture), fat and ash were high in large size. The study has concluded that the large size fishes of *S. barracuda* with high nutritional value when caught in winter from the southern region of Sawakin.

Keywords

Area, Chemical Composition, Season and Size

1. Introduction

Fishes are one of the main foods for humans of many centuries, due to their high nutritional value [1]. It is one of the most important sources of animal protein and other elements for the maintenance of healthy body [2]. Fish protein which contains all the essential amino acids in the right proportions is rich in vitamins

A, B and D and rich in minerals such as Iodine and Phosphorus. Fish flesh is easily digestible due to low percentage of connective tissue [3]. There is a greater difference in flavor and texture between fish species. Although the composition and the amount of protein in fish vary a little from species to species the protein content for meat and for fish is roughly comparable [4]. The chemical composition of fish is affected by various factors such as species, age, size, sex, stage of maturity, month of capture and genetic traits or due to starvation migration and spawning or because of external factors such as shortage of food and the feed composition [5]. The main constituent of fish flesh is water which usually ranges from 70% to 80% depending on the leanness of fish. The water in fresh fish muscle is tightly bound to the protein in such a way that it cannot readily be expelled even under high pressure and after prolonged chilling. However, the proteins are less able to retain all the water and some of it contained dissolved substance. In the living fish, water content usually increases and the protein content decreases with spawning [4]. The amount of protein in fish muscle is about 15% to 20%, with values lower than 15% or as high as 28% in some species [4]. Two essential amino acids called lysine and methionine are generally found in high concentration in fish proteins and highly suited to man's nutritional requirements and compare favourably with that provided by meat, milk and egg. The structure of fish proteins is easily changed by changing its physical environment [5]. The fat content of fish varies more widely than the water, protein or mineral content. Whilst the ratio of the highest to the lowest value of protein or water content encountered is not more than 3:1, the ratio between the highest and lowest fat values is more than 30:1 [4]. Fish may be categorized as lean or fatty depending on how they store fat for energy; lean fish which use the liver as their energy depot or fatty species store lipids in fat cells throughout the body [5]. As for minerals, fish meat is regarded as a valuable source of Calcium and Phosphorus in particular but also of Iron, Copper and Selenium. Saltwater fish have a high content of Iodine; the sodium content of fish meat is relatively low which makes it suitable for low-sodium diets. The amount of carbohydrate in white fish meat is generally too small to be of any significance in the diet. In white fish, the amount is usually less than I %, but in the dark muscle of some fatty species, it may reach 2% [4]. The aim of this study is to determine the effect of area, size and season on the chemical composition of *Sphyraena barracuda*. Knowledge of fish's chemical composition is important for processor, nutritionist and consumer.

2. Material and Methods

2.1. Fish Samples

A total of 180 fish samples of S. *barracuda* were collected from Port Sudan (90) and Sawakin (90) during 2020-2021, in winter (December to February), temperature ranged between 18˚C - 25˚C, and humidity 58%, while in summer (May to June) the temperature ranged between 26˚C - 40˚C, and humidity was 38%. The

collected samples were categorized into two size groups:

A) Small size ranged between (30 - 50) cm in total length and (250 - 1000) gm in body weight.

B) Large size ranged between (60 - 90) cm in total length ranged and (1250 - 250) gm in body weight.

Freshly caught fish, were transported immediately to the laboratory of the Red Sea Fisheries Research Station Port Sudan. All samples were thoroughly washed with tap water, blot dry, total length was measured to the nearest cm, and total weight to the nearest gm (Figure 1).

2.2. Analytical Procedures

Chemical analysis:

Flesh of fresh fish was subject to gross chemical analysis, the parameters studied were, moisture, protein, fat, ash, acidity, pH.

Acidity:

−10 gram from flesh were added to 10 ml distilled water, and homogenized for 10 minute with shaker. To the homogenate 2 drop from phenophthalin indicator (0.5%) were added and the acidity was measured by titration against 0.1N of NaOH [6].

pH:

pH of samples was measured using pH meters (Lutron pH-206, l930533). pH meter calibrating by the buffer solution, after making slurry with water.

Moisture:

Determined by oven drying the sample at (105˚C) until constant weight (abut 16 - 24 hour), Moisture was determined following [6].

Crude protein:

Crude protein was obtained by measuring total nitrogen adopting a modified micro kjeldahl procedure using selenium and copper sulphate as a catalyst for the digestion, and a steam distillation apparatus to find the nitrogen content of

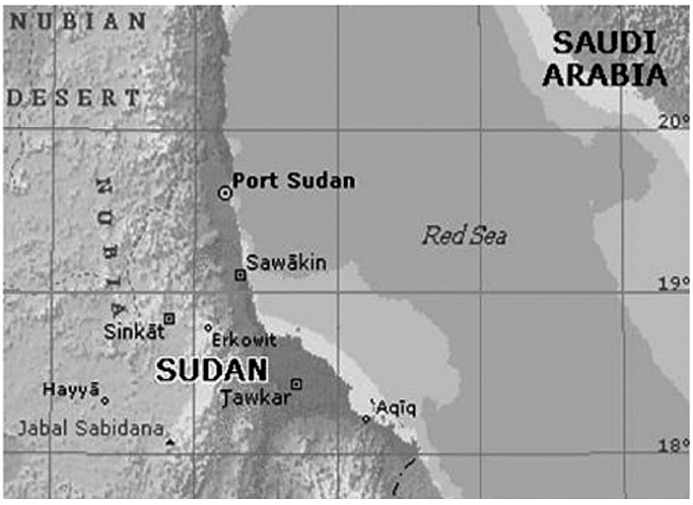

Figure 1. Map of Sampling sites (Port Sudan and Sawakin).

the sample and titrate with (0.1 N) HCl. The value for protein nitrogen was multiplied by a factor of 6.25, which assumes that the fish protein contain 16% nitrogen, to obtain the amount of protein [6].

Fat content:

Fat was determined by extracting 1 gm of dry sample with petroleum ether (boiling 40˚C - 80˚C) for six hours in a soxhelt continuous extraction apparatus. The extract was then dried in a water path until constant weight was optioned [6].

Ash:

Ash content was determined by ignition of dried sample in a muffle furnace at (550˚C - 600˚C) to about (3 - 4) hours then calculated following [6].

Statistical analysis were performed using analysis systems SPSS Completely Randomized Design (CRD) were used to determine the effects of area, seasons, and size on chemical composition (pH, acidity, moisture, ash, protein and fat). 30 samples are replicates for each comparison.

3. Results and Discussion

The major constituents in the edible portion of fish are water, protein, lipid (fat or oil) and ash (minerals). Analysis of these basic constituents is often referred to proximate analysis [7]. Statistical analysis showed a significant effect of areas on crude protein and ash; a higher parameter value is found in Sawakin (**Table 1**). This could be related to opulence of the southern area by primary production from the fresh water which flows during the rainy season from the Red Sea mountains, formed nutrient rich of fish habitats affect their own distribution and abundance [8], Also [9] reported that the catch rate of shrimp is higher in the southern area and so [8] stated that the southern area was rich in bycatch as compared to the northern area.

Table 2 showed that seasons had a significant effect on Crude protein fat and ash in winter. All chemical parameter were higher than summer except ash. [10] found that higher plankton volume was recorded during winter while lower plankton volume was during summer. This primary production correlative to amplitude aliment for fishes, [8] mentioned that the catch in the southern area

Table 1. Effect of different area on the chemical composition (Means ± SD. Error).

No	Parameter	Port Sudan	Sawakin	F-value	p-value	Level of significance
1	pH	6.74 ± 0. 360	6.8 ± 0.361	0.00087	0.976	$p > 0.05$
2	Acidity	0.97 ± 0.165	1.07 ± 0.165	0.196	0.657	$p > 0.05$
3	Crude protein	52.95 ± 0.68	53.29 ± 0.68	1.912	0.042	$p < 0.05$
4	Fat	3.74 ± 0.201	3.75 ± 0.200	0.006	0.93	$p > 0.05$
5	Ash	3.99 ± 0.22	4.22 ± 0.22	1.695	0.0459	$p < 0.05$
6	Moisture	78.15 ± 4.139	78.02 ± 4.145	0.0036	0.952	$p > 0.05$

Table 2. Effect of different season on the chemical composition (Means ± SD. Error).

No	Parameter	Winter	Summer	F-value	p-value	Level of significance
1	pH	6.81 ± 0.361	6.74 ± 0.360	0.004	0.949	$p > 0.05$
2	Acidity	1.02 ± 0.165	1.01 ± 0.165	0.0017	0.966	$p > 0.05$
3	Crude protein	54.48 ± 0.68	51.77 ± 0.68	2.44	0.029	$p < 0.05$
4	Fat	3.84 ± 0.200	3.65 ± 0.201	1.85	0.049	$p < 0.05$
5	Ash	3.86 ± 0.22	4.35 ± 0.22	2.72	0.09	$p < 0.05$
6	Moisture	78.22 ± 4.14	76.17 ± 4.13	0.0008	0.99	$p > 0.05$

Table 3. Effect of different size on the chemical composition (Means ± SD. Error).

No	Parameter	Small size fishes (cm)	Large size fishes (cm)	F-value	p-value	Level of significance
1	pH	6.92 ± 0.360	6.62 ± 0.361	1.05	0.050	$p < 0.05$
2	Acidity	1.11 ± 0.16	0.93 ± 0.16	1.57	0.044	$p < 0.05$
3	Crude protein	53.42 ± 0.681	52.79 ± 0.683	1.051	0.042	$p < 0.05$
4	Fat	3.69 ± 0.20	3.81 ± 0.20	1.757	0.049	$p < 0.05$
5	Ash	4.04 ± 0.22	4.17 ± 0.22	1.871	0.047	$p < 0.05$
6	Moisture	78.12 ± 4.14	78.05 ± 4.13	0.0006	0.97	$p > 0.05$

of Sudanese Red Sea coast was high in January, February, and March low during June to December; [9] reported that the catch rate of shrimp is higher in winter. On the other hand seasonal variations were attributed to physiological and feeding aspects.

The data in Table 3 showed that the difference in fishes size had a significantly affect in the chemical composition except moisture. pH, Acidity, crude protein and energy value were higher in small size fishes, however, fat and ash were high in large size. The ratio of fat and ash were found to be higher in large size fishes, these might be due to accumulation and storage of minerals in fish flesh and bone.

4. Conclusion

The study has concluded that there is significant effect of area, size and season on *Sphyraena barracuda* chemical composition. High nutritional value measured in large-sized in fish caught in the winter from the southern region.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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